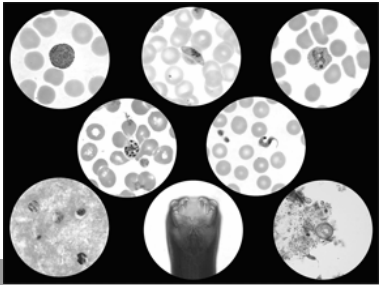


DPDx Parasitology Telediagnosis Assistance:
What is it and what can it do for me?



DPDx

CDC

What kind of name is that?

DPDx is a project developed by investigators from the Division of Parasitic Diseases (DPD) at CDC.

$$D P D + D x =$$

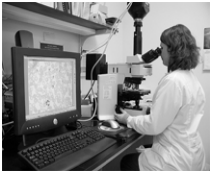
$$DPDx$$

DPDx


CDC

DPDx Project Purpose

Diagnostic assistance to public health labs through telediagnosis



Provide education and training in parasitology




Web site: <http://www.dpd.cdc.gov/dpd>

DPDx

CDC

Telediagnosis Process

Using a digital camera connected to a microscope and a computer with Internet access, laboratorians can transmit images to CDC via e-mail and receive diagnostic assistance in minutes to hours.



Blaine Mathison of the Arizona State Laboratory at his telediagnosis station.

DPDx

CDC

Telediagnosis Process

If you send a request, we need the following information:


- Your name
- Your affiliation and address (for final reporting)
- Telephone number (optional)
- Specimen ID code
- Type of specimen including date, stain used, measurement of the object, and magnification of the microscopic field captured
- Presumed diagnosis
- Any other pertinent data (e.g., pre or post treatment, travel history, etc.)

DPDx

CDC

Telediagnosis Process

When a telediagnosis request comes to DPDx, it arrives in a general mailbox and is then sent out to a group of 4 team members. Other personnel may be brought in if their expertise is needed.



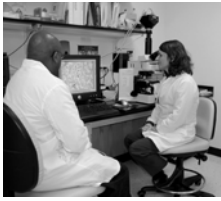
DPDx Team

DPDx

CDC

Telediagnosis Process

After there is consensus among our group, a response is sent back to the requester with either an identification or a request for more information.



Telediagnosis allows laboratorians to address difficult diagnostic cases efficiently and disseminate information more rapidly.

6

DPDx
CDC

Rationale for Telediagnosis

Telediagnosis is a good screening tool.

CDC personnel can see the suspected parasite before specimens are mailed; this allows us to

- 1) confirm parasitic organisms or rule out the presence of these agents
- 2) request all appropriate specimen types necessary for further testing if analysis of images cannot provide definitive diagnosis
- 3) contact subject matter experts outside parasitology if the images indicate the presence of other classes of infectious agents

Telediagnosis is also an efficient teaching tool. Members of the DPDx Team can point out diagnostic features that the submitting labs may have missed

7

DPDx
CDC

Rationale for Telediagnosis

Traditional route for specimen submission

Microscopic exam (PHL)
Approximately 1 hour
\$10.00 labor*

↓

Package and ship specimen
48-72 hours
\$70.00 for shipping and packaging**

→

Diagnostic assistance
Approximately 1 hour
\$15.00 labor†

Using DPDx for specimen identification

Microscopic exam (PHL)
Approximately 1 hour
\$10.00 labor*

↓

Capture image and send email
Approximately 15 minutes
\$2.50 labor*

→

DPDx assistance
Approximately 30 minutes
\$7.50 labor†

1 specimen costs at least **\$95.00** to send and evaluate. Minimum turnaround time of 48 hours when submitted through conventional routes.

1 "specimen" (Images of the specimen + patient information) costs close to **\$20.00** to send and evaluate. Minimum turnaround can be minutes once the image is submitted

* Estimating labor as 10.00/hour
† Estimating labor as 15.00/hour
** Including labor

8

DPDx
CDC

If I don't have it, how do I get it? If I do have it, what if I need equipment upgrades or training?

Request funding through the Epidemiology and Laboratory Capacity for Infectious Disease Cooperative Agreement.

ELC's purpose is to improve surveillance for reportable infectious diseases by providing technical and financial assistance to state health departments.

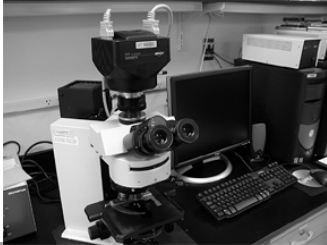
http://www.cdc.gov/ncidod/osr/site/epi_lab/index.htm

9

DPDx
CDC

Cameras

Diagnostic Instruments
SPOT-RT camera
\$9,000-\$12,000




10

DPDx
CDC

Cameras

Micropublisher
\$6,000-8,000



Magnafire
\$9,000-\$17,000

Olympus, DP70
\$8,000

11

DPDx
CDC

Monitor:

12

Video Card:

One available PCI slot

Operating System: Windows 2000 or higher.

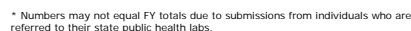
DPD_x

CDC

14



15

DPD_x

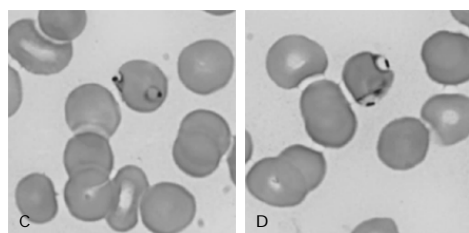
CDC

16

DPD_x

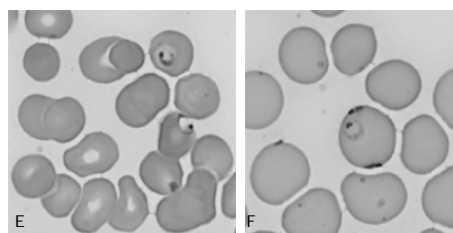
CDC

17

DPD_x

CDC

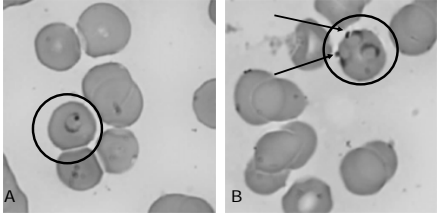
18

DPD_x

CDC

Telediagnosis -- malaria

19



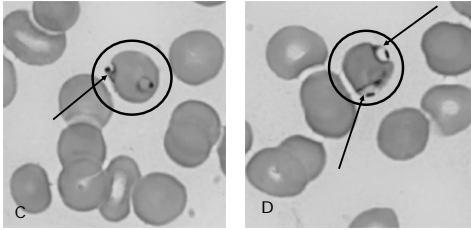
A B

DPDx

CDC

Telediagnosis -- malaria

20



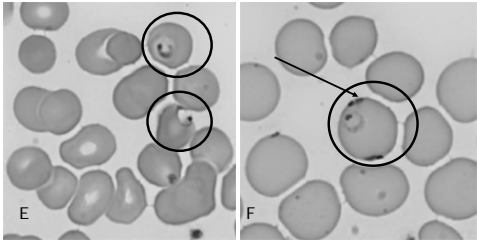
C D

DPDx

CDC

Telediagnosis -- malaria

21



E F

DPDx

CDC

Telediagnosis -- malaria

22

Based on the images, 3 DPDx team members reviewed and agreed on the identification of *Plasmodium falciparum*.

The images were cropped slightly for this presentation, but the requester did the following correctly:

- Provided all case history that they had, including travel, and a presumptive diagnosis
- Sent multiple images taken from various fields of the slide, although only from the thin smear
- Included uninfected red blood cells in the images for size comparison with infected cells

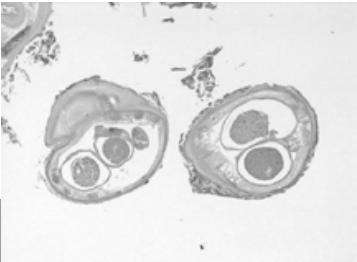
DPDx

CDC

Telediagnosis -- tissue section

23

I sent a photo of an H&E slide to your web site diagnostic center. I am unsure if you received the photo as I have not heard anything yet. The patient is a young adult who recently moved to the area from Africa. The patient discovered an inguinal mass, which was thought to be a lymph node. A biopsy demonstrated a 'ball of worms'. We are unable to identify the worm based on morphology and would like your help!



DPDx

CDC

Telediagnosis -- tissue section

24

Problems with this telediagnosis request:

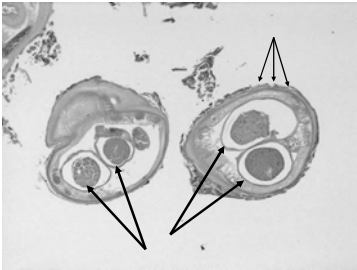
- Requester sent only one image
- No magnification given
- No specific location in Africa given

DPDx

CDC

Telediagnosis – tissue section 25


After input from one of the DPDx team members, and consultation with our resident nematode expert, we were able to provide an identification of *Onchocerca volvulus*.



DPDx CDC

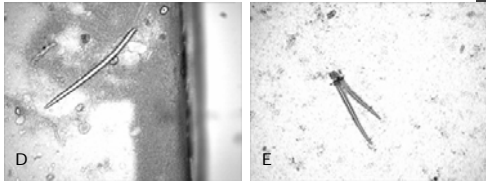
Telediagnosis – possible helminth 26

I'm sending some pictures of a "parasite" they found in a feces sample in a hospital, they are strange looking formations. *Strongyloides stercoralis*??



DPDx CDC

Telediagnosis – possible helminth 27



DPDx CDC

Telediagnosis – possible helminth 28

Problems with this telediagnosis request:

- No magnification given
- No size measurements on the objects
- No patient history

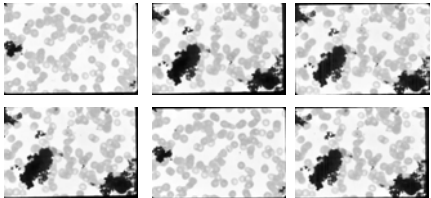
But our DPDx team members were able to provide an identification of *no parasites found*. Probably plant material.

DPDx CDC

Telediagnosis – possible malaria 29

Attached are slides of a presumptive *Plasmodium* species.

Patient is a young adult. Geimsa stained smears were prepared on [date given by requester]. The magnification used is 100x. Patient has a recent travel history to West Africa. * specimen id was sent

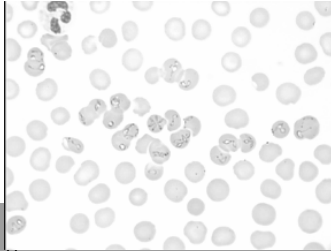


Unable to provide an identification, larger images necessary.

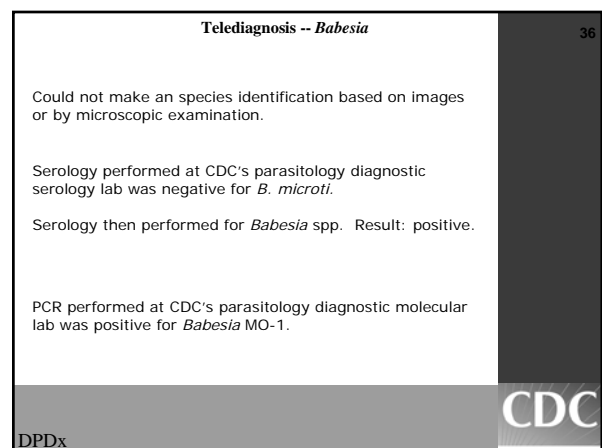
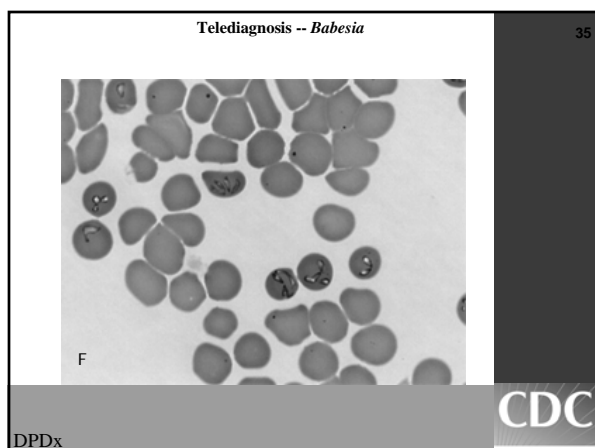
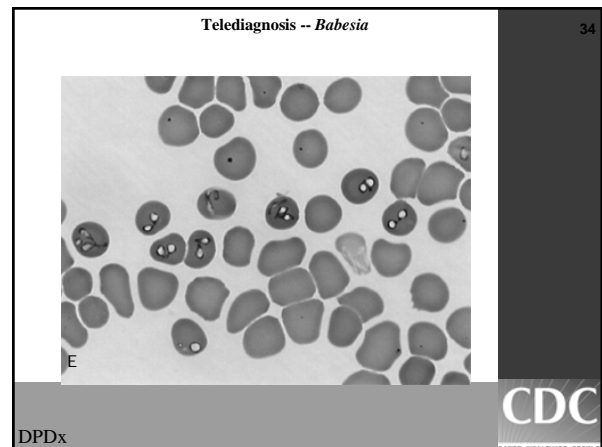
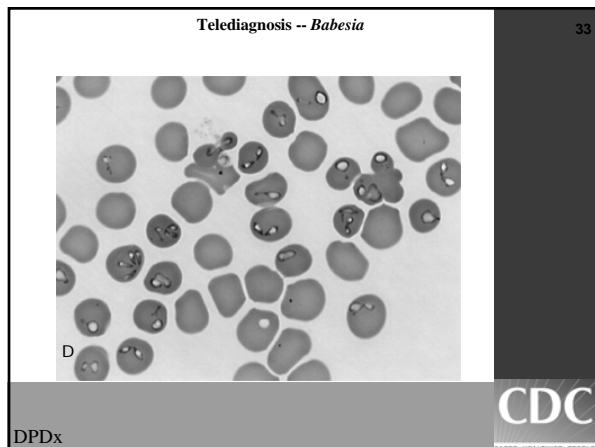
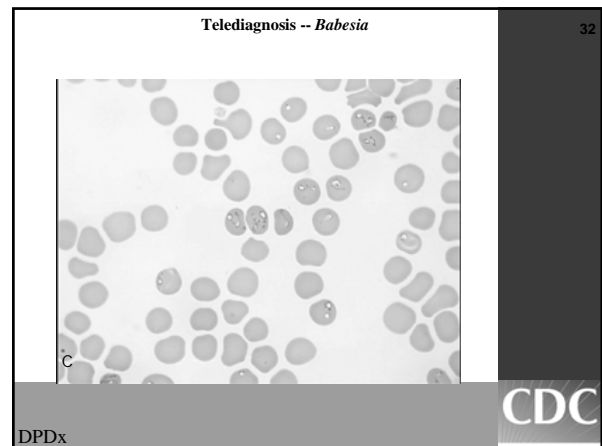
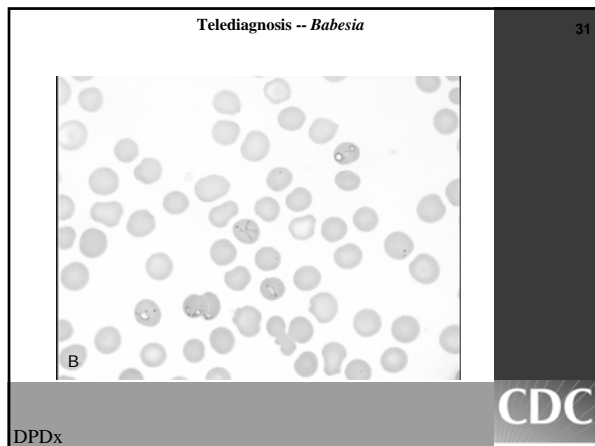
DPDx CDC

Telediagnosis -- Babesia 30

Elderly patient
no history of tick bite/exposure or transfusions until current admission
hospitalized several months previously; babesiosis diagnosed by blood smear
developed recurrent symptoms ~ 2 weeks ago
had spleen removed several years ago
Is infected with *Babesia* but what species?

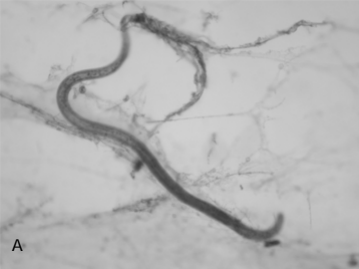


DPDx CDC



Telediagnosis -- helminth 37


I trust that you received the serum, stool, and BAL fluid we submitted. We received digital photographs of the parasite recovered from this patient taken by microbiology staff at the location this patient is currently being treated. I'm hopeful that these photographs may be helpful to you in making a confirmatory identification of this parasite.




A

DPDx CDC

Telediagnosis -- helminth 38



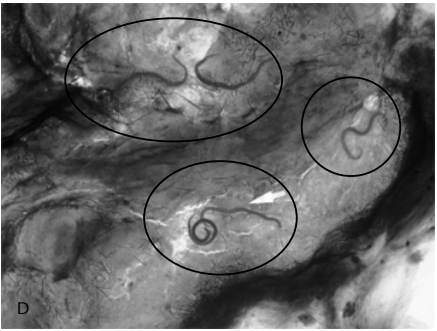
B



C

DPDx CDC

Telediagnosis -- helminth 39



D

DPDx CDC

Telediagnosis -- helminth 40

Based on the images, we agreed that this looked like *Strongyloides stercoralis*.

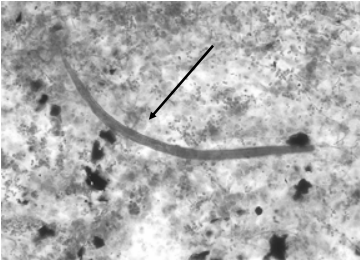
What did the requester leave out that was important?

Size.

DPDx CDC

Telediagnosis -- helminth 41

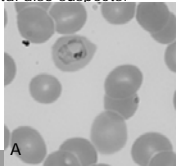
Microscopy: *Strongyloides stercoralis*
Serology: + for strongyloidiasis



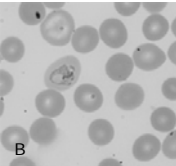
DPDx CDC

Telediagnosis -- malaria 42

The patient is a middle aged. He grew up in Nigeria and recently visited there. He is not aware of having had malaria in the past. His children returned from Nigeria with malaria, I was not told the type. He is now suffering from fevers and body aches. The patient is being treated with chloroquine. The people the hospital found banana shaped gametocytes (though I haven't yet) and so have determined he has *P. falciparum*. But they also found schizonts, enlarged infected red blood cells, amoeboid trophozoites and I am sending you images of these. They are suggestive of *P. vivax* which the hospital also suspects.

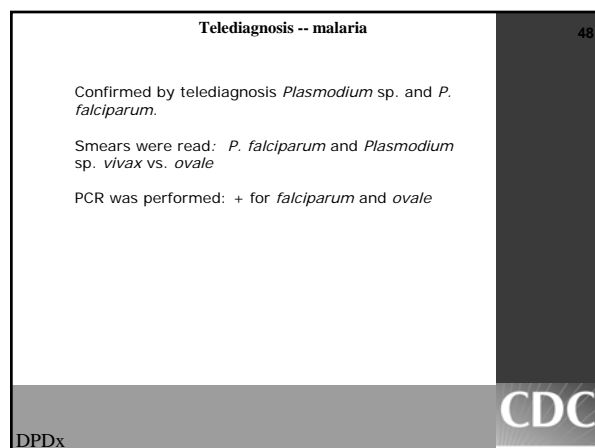
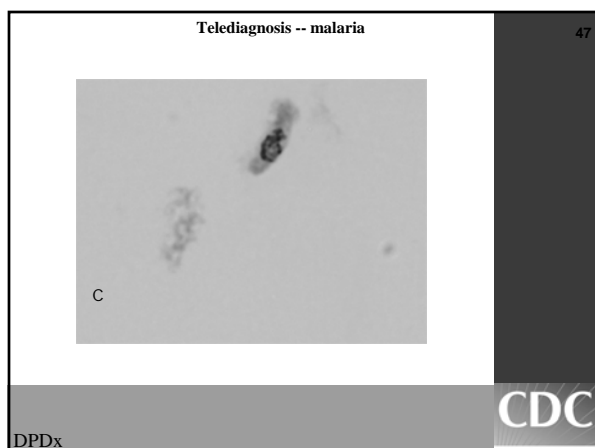
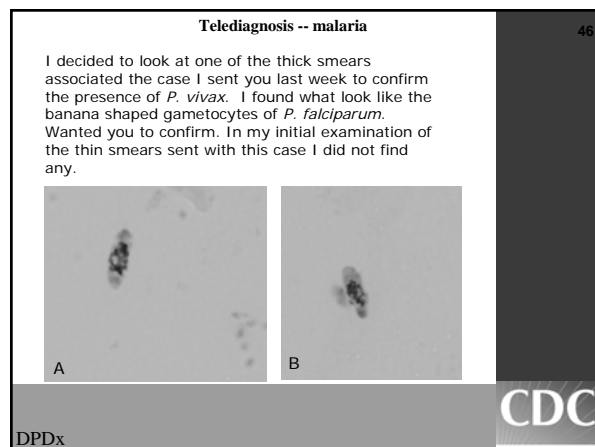
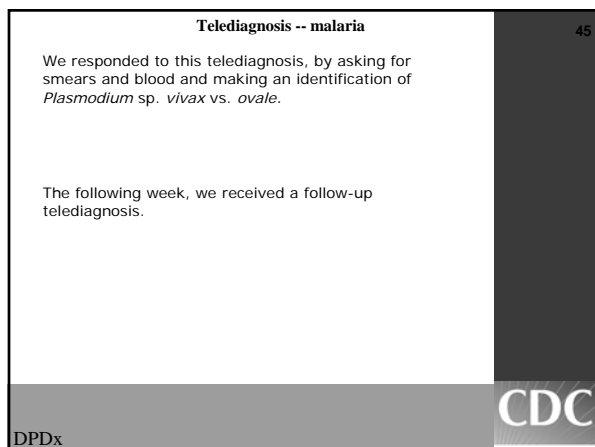
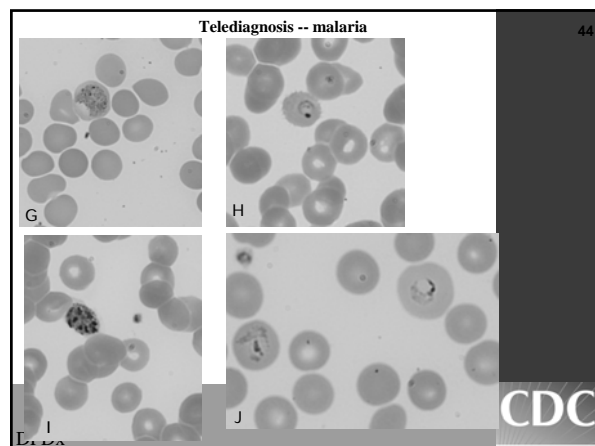
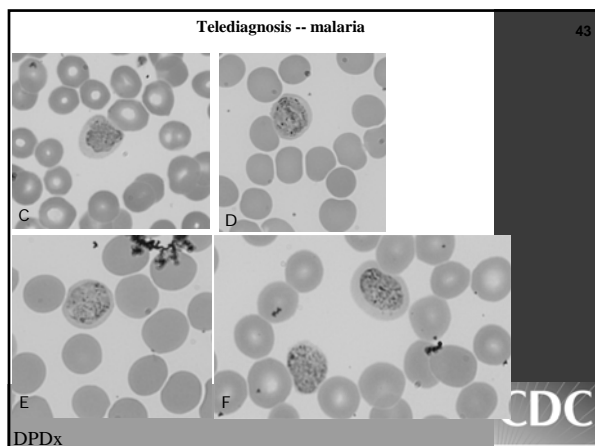


A



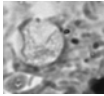
B

DPDx CDC

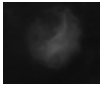


Teliediagnosis -- outbreaks

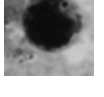
49



Patient 1



Patient 2



Patient 3

CDC

DPDx

Teliediagnosis -- outbreaks

50

No size given

Stain type not given

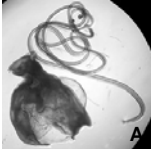
CDC

DPDx

Training applications

51

A 70-year-old man was seen by an ophthalmologist for eye pain. Upon examination, the doctor found and removed a subconjunctival worm that was enclosed in a cyst. The man had no recent travel outside the United States (had traveled to Central America over 5 years ago) and reported that he did have pets at home.




A: The cyst and the worm it contained: the worm was approximately 92 mm in length.

CDC

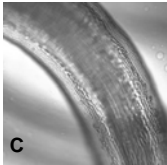
DPDx

Training applications

52



B: Posterior end of the worm at 100x



C: Midbody of the worm at 200x.

CDC

DPDx

Training applications

53

A male filarial worm in the genus *Dirofilaria*, most likely *Dirofilaria tenuis* (based on absence of travel history and given the geographical location of the patient's residence) The presentation of the worm in a cyst is not typical, but the morphology of the worm was consistent with the features of *Dirofilaria*. Diagnostic features observed were:


Size: 92 mm

CDC

DPDx

Training applications

54



100x

Caudal (tail) papillae shown in Image **B** (green arrow).

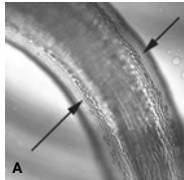
Spicule (Image **B**, red arrow). The presence of papillae and spicule indicated this was a male worm.

CDC

DPDx

Training applications 55

The ridging and striations of the cuticle shown in Image **A** below appear beaded, in a "corn row" effect (blue arrows), indicating that the worm belonged to the genus *Dirofilaria*.



200x

DPDx CDC

Training applications 56

A 39-year-old female had a descending colon biopsy to determine the cause of symptoms that included chronic abdominal pain and discomfort. No pertinent travel history was known. Worm-like objects were detected during the biopsy, and some were recovered. The specimens were sent to a state health department laboratory for identification. Lab personnel at the state took digital images (Figures **A-C**) and sent them to DPDx at CDC for assistance in making an identification via telediagnostics. What is your diagnosis? Based on what criteria?

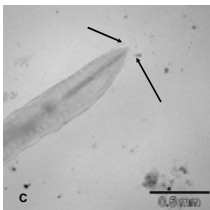


DPDx CDC

Training applications 57

We suspected that this was a case of enterobiasis caused by *Enterobius vermicularis* (pinworm). Diagnostic features were:

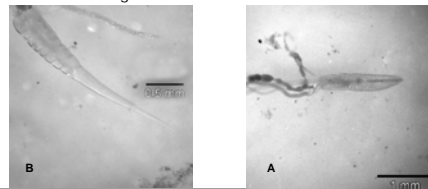
- Presence of cephalic inflations on the anterior end.



DPDx CDC

Training applications 58

- Absence of spicules in the images of the tail suggest this was a female worm. The tail of a female pinworm is long, tapered, and slender.
- Presence of eggs in the exposed uterus confirming that this was a female pinworm. However diagnostic features of the eggs could not be determined by the magnification at which the images were taken.




DPDx CDC

Training applications 59

The DPDx Team asked laboratory personnel at the South Carolina Bureau of Laboratories to try to "tease out" some eggs, photograph them, and submit an image to verify the initial diagnosis.

- The personnel promptly complied and the following image submitted of the egg below shows a typical pinworm egg based on size (50-60 by 20-32) and shape (oval with one side flattened).



DPDx CDC

Tips 60

- 1) When using lower magnification objectives (e.g., 10X - 40X) you can increase the contrast of the image by adjusting the condenser's aperture setting according to the objective you're using.
- 2) Always do a white balance prior to a image capturing session or when switching between differently stained slides.
- 3) Always make a copy of your image file before using image editing software to alter the image.
- 4) You can reduce file size by saving images as .jpg files instead of as .tif files.

Please contact us for additional instructions and tips on image capturing.

DPDx CDC

DPD_x

For more information

Send us an e-mail at dpdx@cdc.gov

Visit our Web site at <http://www.dpd.cdc.gov/dpdx>

DPD_x

CDC

For
Individual Registration
Evaluation
CEU Certificate
Go to PHTN :
www.phppo.cdc.gov//phtnonline
Passcode = PARADITE
Complete by November 19, 2005

DPD_x

DC